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Diagnostic characters of three nymphal instars and morphological features of adult Collard-dove louse *Columbicola bacillus* (Phthiraptera : Insecta)

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Abstract
The morphological features of three instars of nymphs and adults of *Columbicola bacillus* (Ischnocera: Phthiraptera) collected from Collard-dove *Streptopelia decaocto* were studied. Present report furnishes Second instar nymph can be separated from first instar due to appearance of additional seta on pterothorax on seventh to eight adominal segments. Third instars can be distinguished from second instar due to appearance of pleural seta on abdominal segment seventh to ninth.

Keywords: Avian louse, Chaetotaxy, Colard-dove, *Columbicola*, Ischnocera, Phthiraptera

INTRODUCTION

Lakshminaryana (1979) provided a checklist of phthirapteran ectoparasites parasitizing birds and mammals of India and adjacent countries. Price *et al.* (2003) offered a comprehensive checklist of phthirapterans infesting birds throughout the world. While revising the genus Adams *et al*. (2005) provided basic information about the morphological features of the lice belonging to *Columbicola* Ewing. Singh *et al*. (2013, 2018) have provided information regarding *in vitro* biology, chaetotaxy and biometry selected ring dove lice.

The morphological features of adults are generally used in systematic studies on avian lice. However, the three nymphal instars of any louse species appear quite similar (except the size) and their identification is a challenging task. In other words, the developmental stages (nymphs) of related taxa look alike and are difficult to differentiate. While describing *in vitro* bionomics of selected avian lice, certain workers have given an account of morphology of their nymphal instars (Martin, 1934; Wilson, 1939; Conci, 1956 a, b; Arora & Chopra, 1959; Agarwal, 1967, 2011). Specific studies on the nymphal morphology of selected Phthiraptera have been made by Clay (1958) and Modrzewska & Zlotorzycka (1987). Mey (1994) made first comprehensive attempt to deduce the phylogeny of ischnoceran bird lice on the basis of the external morphology of nymphal instars. Price and Hellenthal (1996) have indicated the importance of nymphal morphology to elucidate the louse relationship. Futhermore, Smith (2000), Beg *et al*.(2004) and Agarwal *et al.* (2011) have Provided diagnostic characterstics for differentiation of three nymphal instars of selected avian lice. Present report furnishes information on the chaetotaxy of three nymphal instars of *Columbicola bacillus*. Furthermore, additional remarks on morphological features of the louse have also been supplemented.

MATERIALS AND METHODS

Thirty adults and three nymphal instars of *C. bacillus* were obtained by delousing (Gupta *et al*. 2007) the Collard-dove (*Streptopelia decaocto*) in district Rampur. The louse load was separated according to sex and stage. Permanent slides were prepared (by maceration-10% KOH, dehydration through ethanol series, clearing in clove oil, mounting in Canada Balsam) according to method given by Palma (1978). Drawing were made with the help of Camera lucida and identification of lice was based on literature provided by Adams *et al*. 2005.

OBSERVATIONS

Adult morphology (Plate I, Photo1-6) :

Head (Plate I, Photo 1, 4)- Triangular, non-circumfasciate, anterior head margin narrowly convex forming a thin hyaline margin, clypeal suture narrow, clypeus with no sculpturing, bearing two pairs of anterior spines, each pair in dorsal and ventral position; marginal carina forms a band and separated from postmarginal carina by lateral marginal suture, dorsal carina expanded; ventral carina complete, surrounding pulvinus, transverse carina present; conus blunt in both sexes, smaller than scape; antennae heteromorphic, scape in male longer than the female, pedicel long with lateral hook like projection on its distal end in male. Gular plate short and weakly sclerotized, smooth and rounded posteriorly; margins of temple rounded, smooth; marginal temporal carina thin at temples and thicker at post ocular region, post ocular setae present, normal microsetae, behind lens; ocular setae normal, microseta on the lens; postocular nodus weakly developed.

Thorax (Plate I, Photo 2, 5): Prothorax rectangular, anterior setae absent, rhombic sclerite between head and prothorax large, cup shaped; posterolateral setae present on each side; pterothorax larger than prothorax, lateral margins parallel, posterior margin straight, slightly pointed on abdomen, three very long and two normal setae present on posterior margin on each side, mesothoracic spiracle present, meso-metasternal plate present legs well developed, mesothoracic and metathoracic legs pleurocoxal in articulation; pterothorax and abdominal segment II fused ventrally.

Abdomen (Plate I, Photo 3, 6): Elongated, slender, with lateral margins subparallel to slightly convex, tapering at terminalia; tergum I absent; abdominal segment II smaller, not deep into abdominal segment III, abdominal segment III largest among all segments; six pairs abdominal spiracles present; tergopleural sclerotization; pleural ribs enlarged, narrow; sternal plates present, fused medially, weak sclerotization; one posterolateral setae on tergite I, two on tergite II-VII, three on VIII segment; one median to submedian sternal seta on sternite IV-VII, two seta on VIII segment.

Male Terminalia (Plate I, Photo 6): Tergal plates IX and X fused, rounded, convex; terminal segment bearing rows of four pairs of spiniform short setae dorsally and lateral tuft of short and long setae ventrally; anus dorsal in position; subgenital sclerite present.

Female Terminalia (Plate I, Photo 3): Simple; vulval margin narrow, thick, with a minute genital opening in the centre of subgenital plate; two vertical row of short, spini like micrasetae at laterals of subgenital plate present.

Male Genitalia (Plate I, Photo 6): Male genitalia armature shorter and broader with thick struts, thick parameres, mesosomal anterior hole at apical margin, posterior mesosomal holes are small.

Nymph morphology (Fig. 1, A-D) :

First instar nymph (Fig.1, A): The description of the first instar nymph is based on the characters of 4-5days old specimens reared in the laboratory. The nymph measures 1.0mm in length and 0.2mm in breadth. It is elliptical in shape and pale white in colour. The head is as long as broad. The preantennal region being slightly narrower than the post -antennal and temporal region. It is broadly rounded anteriorly and bears two distinct microsetae on the top. Coni are feebly developed. Eyes not seen. Ventral carina feebly seen. The post-antennal region is widest just behind the ocular region. Only the cutting edges of the mandibles are brown in colour. The hypopharynxis poorly developed. Antennae are filiform having five segment, scape is larger than other four segments, three flagellomeres are nearly equal in length.

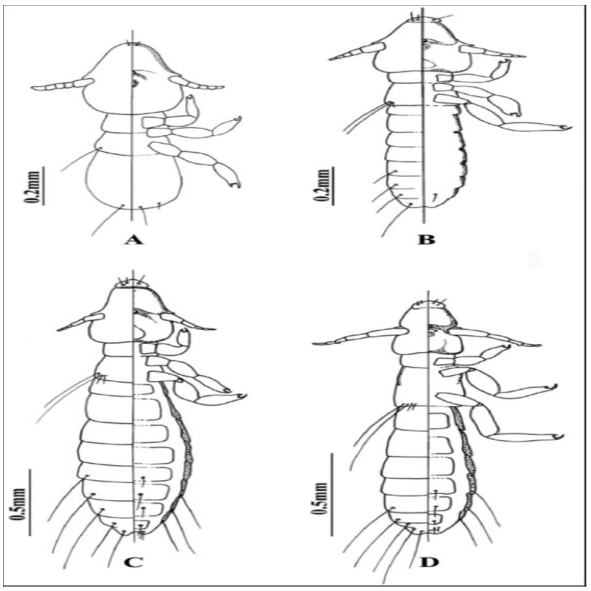
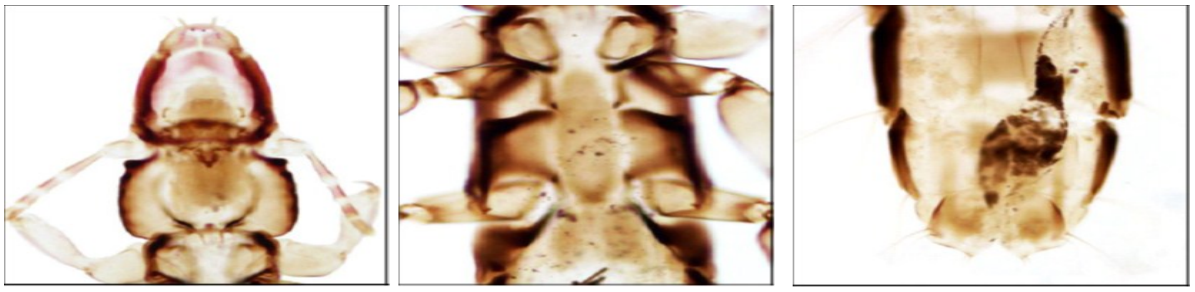
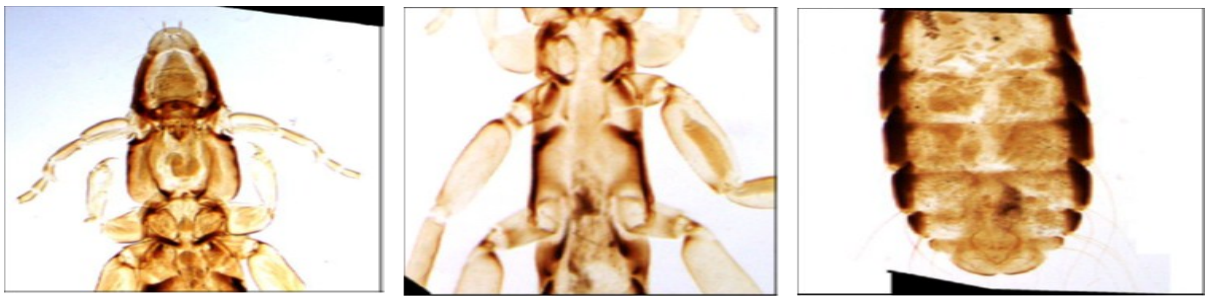


Fig. 1 (A-D). Figs. 1(A-D): Dorso-ventral aspects of three instar nymphs of *Columbicola bacillus*. A. First instar nymph; B. Second instar nymph; C. Third instar nymph (female); D. Third instar nymph (male); *D. Third instar nymph (male)*



1. Head region x 60 **2. Thoracic region x 72** **3. Abdominal segments x60**
***Columbicola bacillus*, Adult Female**



4. Head region x 45 **5. Thoracic region x 45** **6. Abdominal segments x 50**
***Columbicola bacillus*, Adult Male**

Plate 1: Showing enlarge view of Head, Thorax and Abdomen region of Adults (Female and male) of *Columbicola bacillus.*

Gular plate and other structures remain unpigmented and unsclerotized and therefore, not clearly visible. Temporal margins rounded. Temporal carina absent. The prothorax is rectangular, small, lateral margins straight. The pterothor axis slightly longer than prothorax, posterior margins slightly pointed on abdomen, lateral margins smooth bear one seta at the postero lateral angle on its dorsal surface. The pro-and ptero-sterna are devoid of setae. The legs are well developed. The first pairs of legs are the shortest. The claws of the second and third pairs of legs are longer and slender than those of first pair. Abdomen short and 'U' shaped. Abdominal segmentation absent. One tergal setae present on dorsal margin of last segment and two short setae present on the ventral margin of last segment.

Second instar nymph (Fig. 1, B): The second instar nymph resembles the first instar nymph in general characters and appearance but differs in size, chaetotaxy and pigmentation. The nymph is creamy white in colour, measures 1.37mm in length and 0.23mm in breadth. The head of second instar nymph is larger than that of first instar. It shows browning at some places, specially near the incrassations, hypopharynx, mandibles and the tentorial bridge, indicating hardening of these structures. Coni well developed. Eyes feebly seen. Gular plate and temporal carina feebly seen due to pigmentation. Two small dorsal and one ventral setae present on the upper margin of the head. The lateral margins of prothorax and pterothorax, and the dorso-lateral margins of the legs become brownish and represent the first visible indication of sclerotization in the thoracic region. The length of pterothorax increases than that of first instar. Two long setae present on posterolateral angle and one short seta presen ton posterior margin of pterothorax. Abdomen becomes elongate and takes slender shape. Abdominal segmentation feebly seen on dorsal surface. Nine distinct segments are present. Third abdominal segment is larger than other segments. Pleural plates poorly seen. One long tergal seta present on VI, VII, VIII and IX segment on each side. One microsternal seta present on VIII abdominal segment on ventral side.

Third instar nymph (Fig.1 C & D) : The third instar nymph resembles the second instar nymph in general characters. But for the first time sexual dimorphism, in the characters of the first two antennal segment, became evident at this stage. This character enables the separation of nymph into two types, those with the stout first antennal segment and hook like out growth at the distal end of second antennal segment, which after the third moult will produce the male (Fig.1, D) and those in which the first antennal segment is normal and which after the third moult are destined to produce the female (Fig. 1, C). Therefore, the former has been called the male nymph and the latter the female nymph. Other characters in which these differ from the second instar and approach the adult stage are increase in size, enlargement of the pigmented areas on the head, thorax, legs and abdo-

men. The male nymph measures 1.67mm in length and 0.32mm in breadth, whereas the female nymph measures 1.87mm in length and 0.33mm in breadth. The head shows greater browning of the mandibles, the hypopharynx, the increassations and the tentorial bridge becomes distinct showing further hardening. The antanna of the male nymph is slightly different from that of the female nymph. First segment is longer and broader than that of the female antenna while the second segment shows distally the rudiment of the hook like out growth characteristic of the adult male. The gular plate becomes further differentiated. The pro and ptero-thorax of the third instar nymph resemble to those of the second instar nymph, in shape. Two long setae present on the postero-lateral corner and two small setae present on posterior margin of the ptero-thorax on each side. The legs are almost like those of the second instar nymph, but show further increasein pigmentation. Abdomen increases in length. Second abdominal segment largest among all the segments. Pleural plates become darker in pigmentation. One long tergal seta present on VI, VII, VIII and IX segment on postero-lateral angle. One micro seta present on VI, VII, VIII and IX segment on ventral side. One long pleural seta present on VII, VIII and IX segment. One long and two short setae present at terminal end in both sexes.

DISCUSSION

Adams *et al.* (2005) have revised the genus *Columbicola,* while describing eight new species. According to Adams *et al*. 2005, genus *Columbicola* is one of the most spicose genera of chewing lice (with 77 species recognized, so far) and can be recognized due to presence of a pair of blade like dorso anterior setae, 2-3 long metasternal setae, bilobed dorso anterior head plate (with a pair of broad anterior medial setae, abdominal tergite 2-9 medially divided and sexually dimorphic). *C. bacillus* appears quite similar to *C. columbae* but can be recognized by the nature of genitalia, anterior mesosomal pore surrounded by narrow pigmented border and a mesosome with small posterior projection. The specimens of *Columbicola* collected during present study resembled to *bacillus* (in morphological features and measurements) to a greater extent.

In case of *C. bacillus* the first instars can be easily identified due to absence of abdominal segmentation and lack of sclerotization. The second instars can be separated from first instars due to appearance of one large seta (in addition one present in first instar) at postero-lateral angle and one seta on posterior margin of pterothorax and appearance of seta on seventh and eight abdominal segment. Likewise, third instar nymphs can be differentiated from second instars due to better sclerotization of head component, darkening of pleural plates, development of dimorphic character of antennae and terminalia and apperance of pleural setae on seventh to ninth abdominal segments.

Conclusion

Identification and characterization of three nymphal instars of the avain lice is an challenging task. Three nymphal instars of Collard-dove louse, *Columicola bacillus* can be differentiated on account of number of seta on pterothorax and seventh to ninth abdominal segment.

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